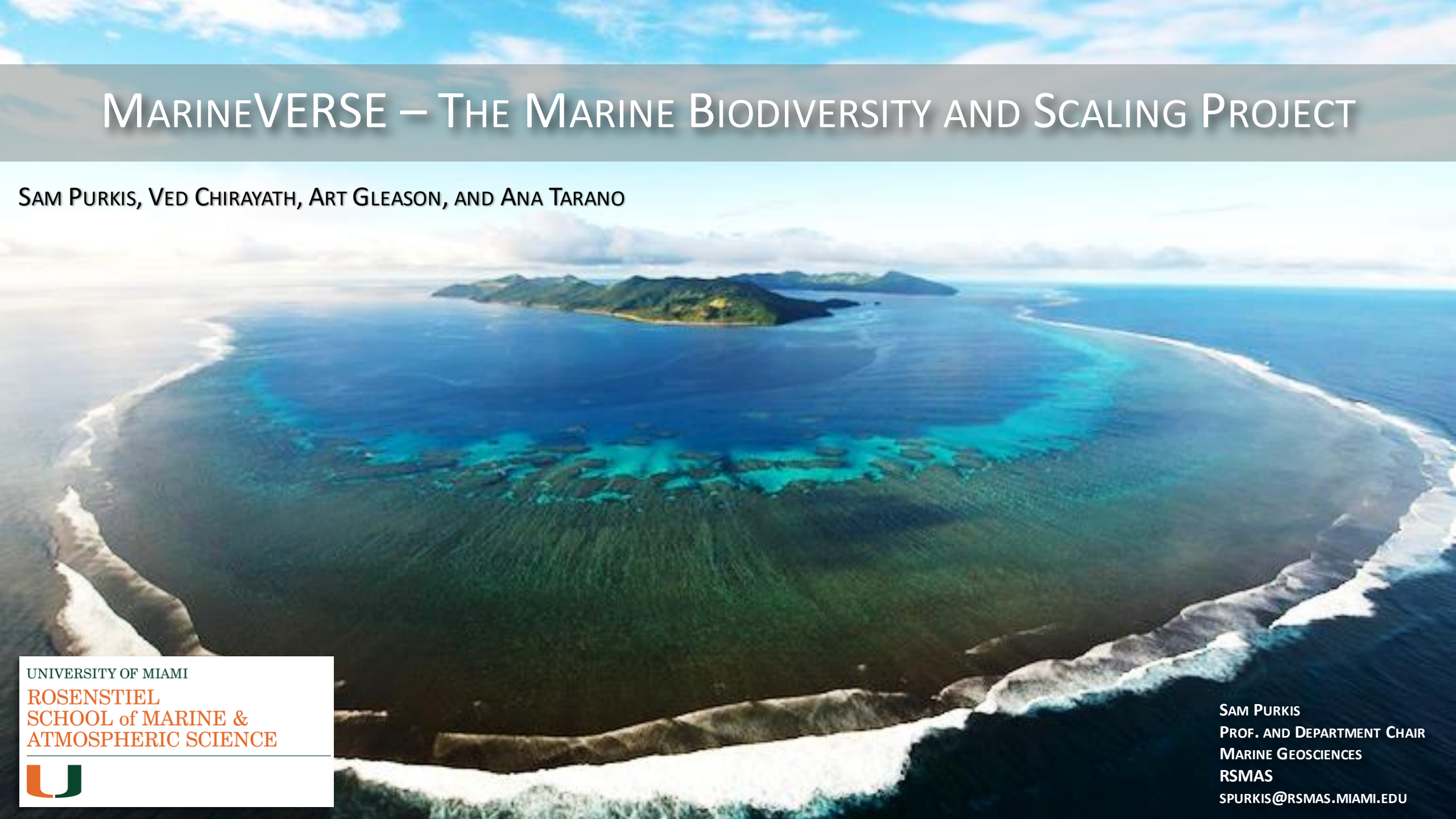
MarineVERSE – The Marine Biodiversity and Scaling Project

Sam Purkis, Ved Chirayath, Art Gleason, and Ana Tarano



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Coral Reefs as a Model Ecosystem (But also an Imperiled One)

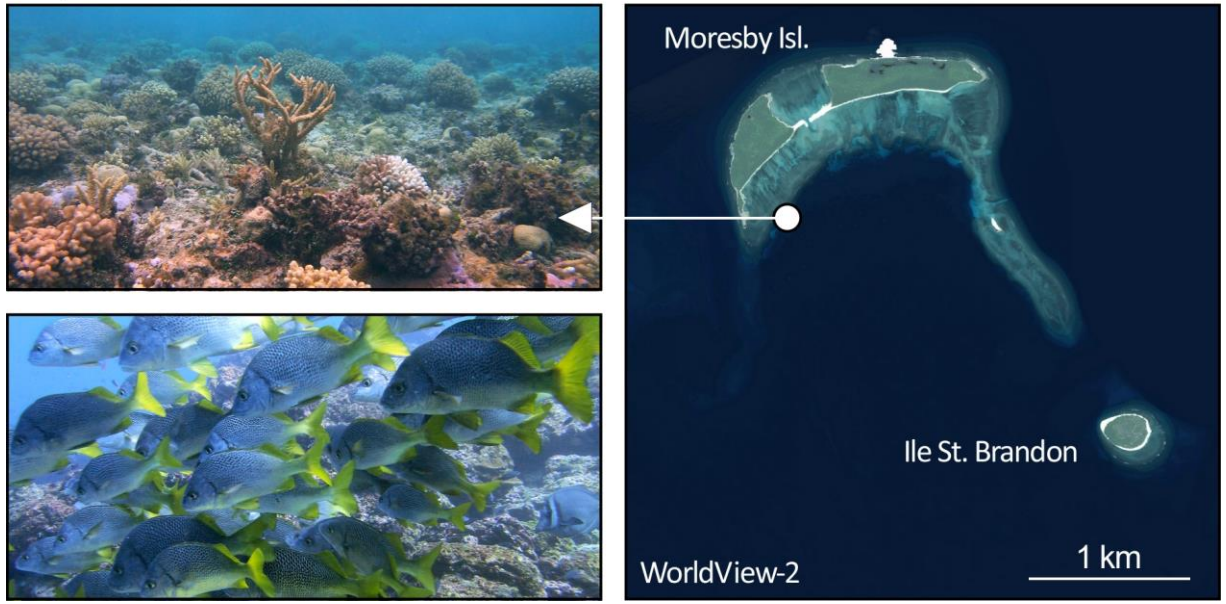
3-Yr. project – Kick-off May 2022

MarineVERSE Considers Three Remote Sensing Questions

1. α-to-Spectral Diversity to Hypothesis
2. α-to-β Diversity Hypothesis
3. Detecting Ecosystem Transitions from Self-Organization

KEY TERMS

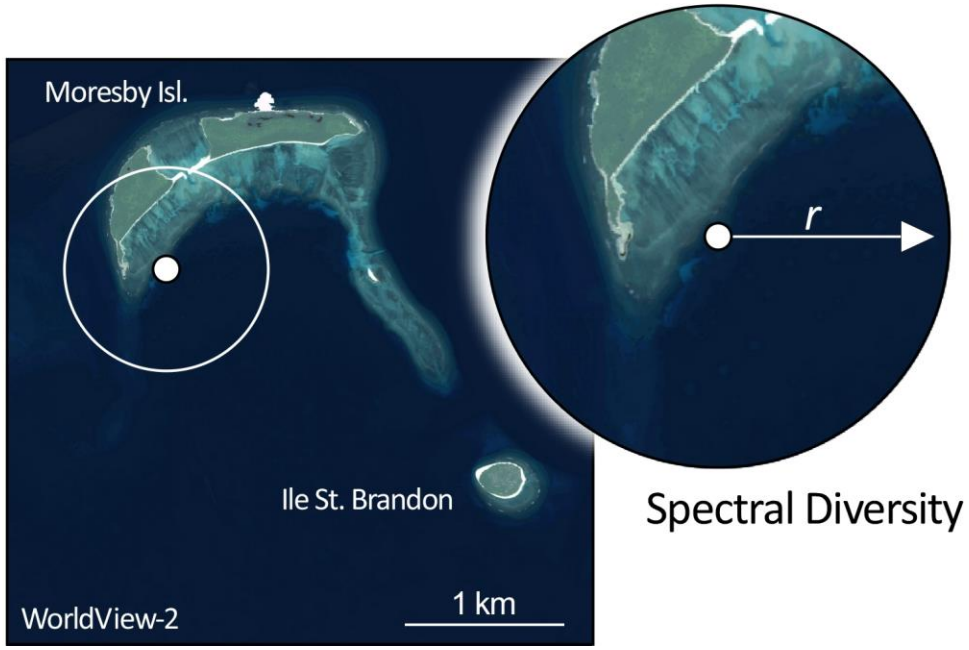
α (*in situ*) Diversity



- Measured by divers
- α-diversity captures species diversity at a local scale
- Measured using a range of proxies including species-richness, species-variation, and species-evenness.
- Else metrics such as **Shannon's** and Simpson's Indices
- Typically applied to corals or reef fish

KEY TERMS

α (*in situ*) Diversity

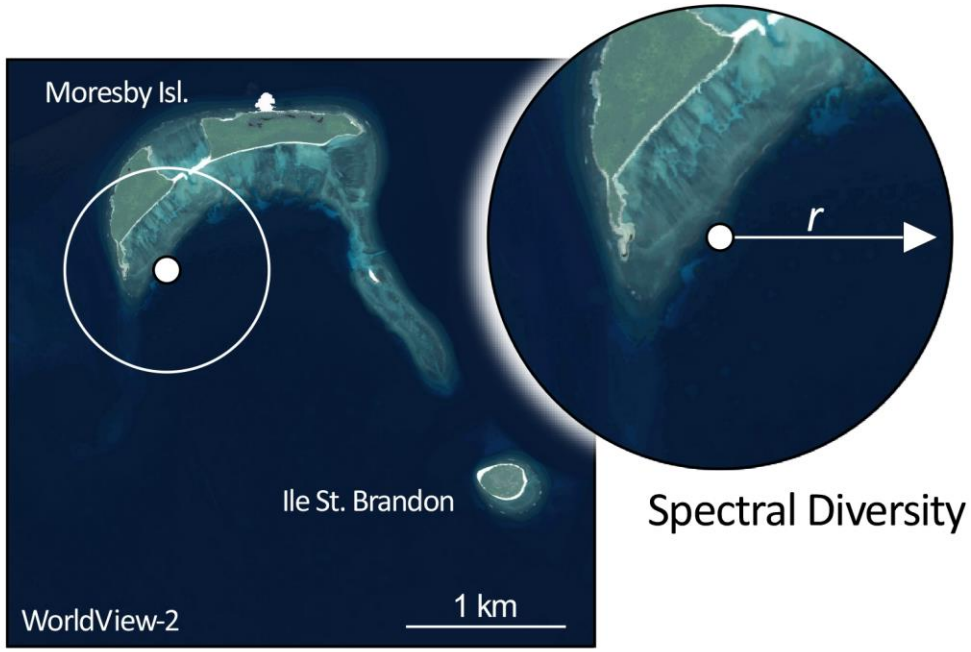


Spectral Diversity

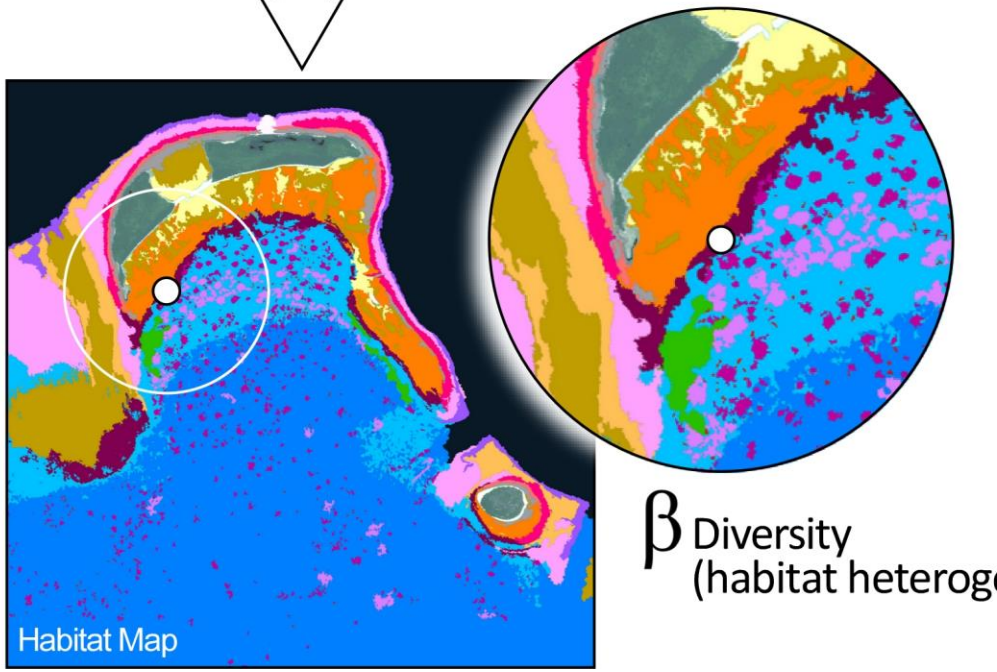
- Derived from remote sensing imagery
- Refers to variation in spectral intensity and/or reflectance, across sets of pixels
- **Rao's Q**
- Terrestrial studies posit that spectral variation is a surrogate for ecological niches, in turn predictive of biodiversity

KEY TERMS

α (*in situ*) Diversity



Spectral Diversity



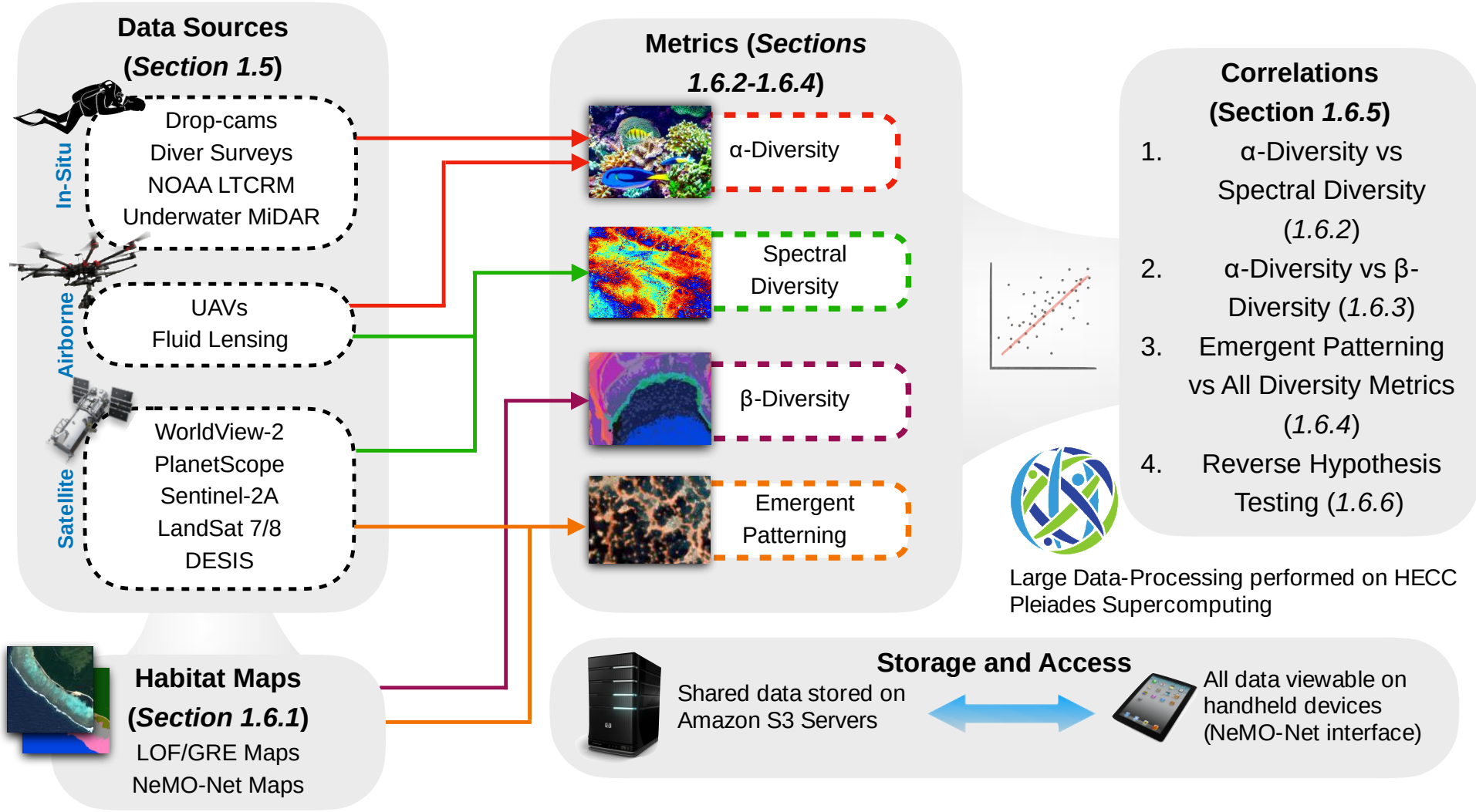
β Diversity
(habitat heterogeneity)

- A measure of spatial variation in benthic character
- Synonymous with 'habitat heterogeneity'
- **Shannon's** diversity

NASA MARINEVERSE

THE MARINE BIODIVERSITY AND SCALING PROJECT (NASA ROSES BIODIVERSITY AWARD 20-BIODIV20-0108)

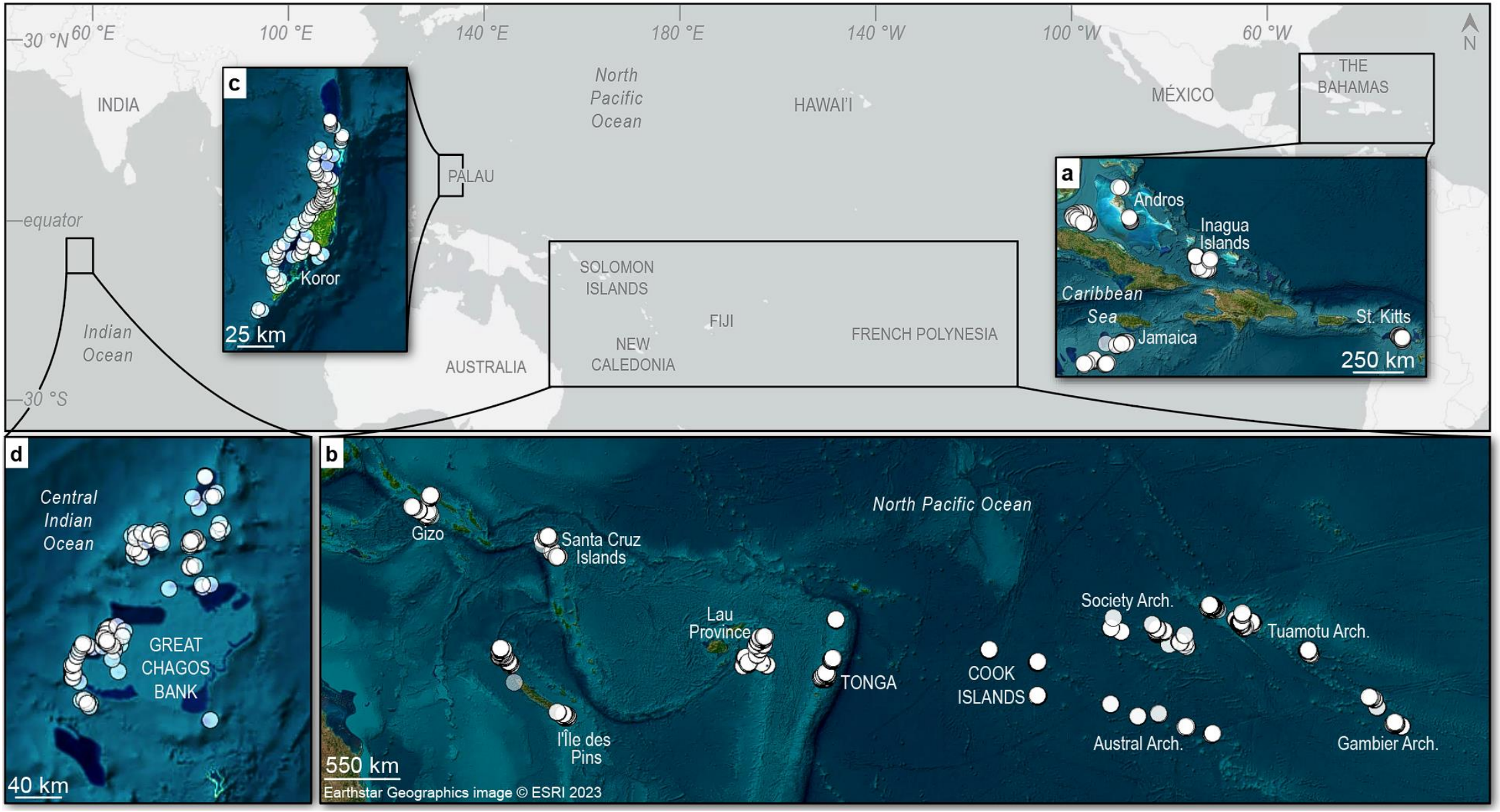
- MarineVERSE takes coral reefs as a model ecosystem and takes four approaches to amplifying our ability to remotely sense ecosystem-scale biodiversity



LIVING OCEANS FOUNDATION – GLOBAL REEF EXPEDITION

Khaled bin Sultan
Living Oceans
Foundation

LIVING OCEANS FOUNDATION – GLOBAL REEF EXPEDITION



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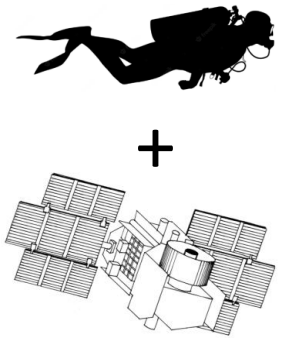
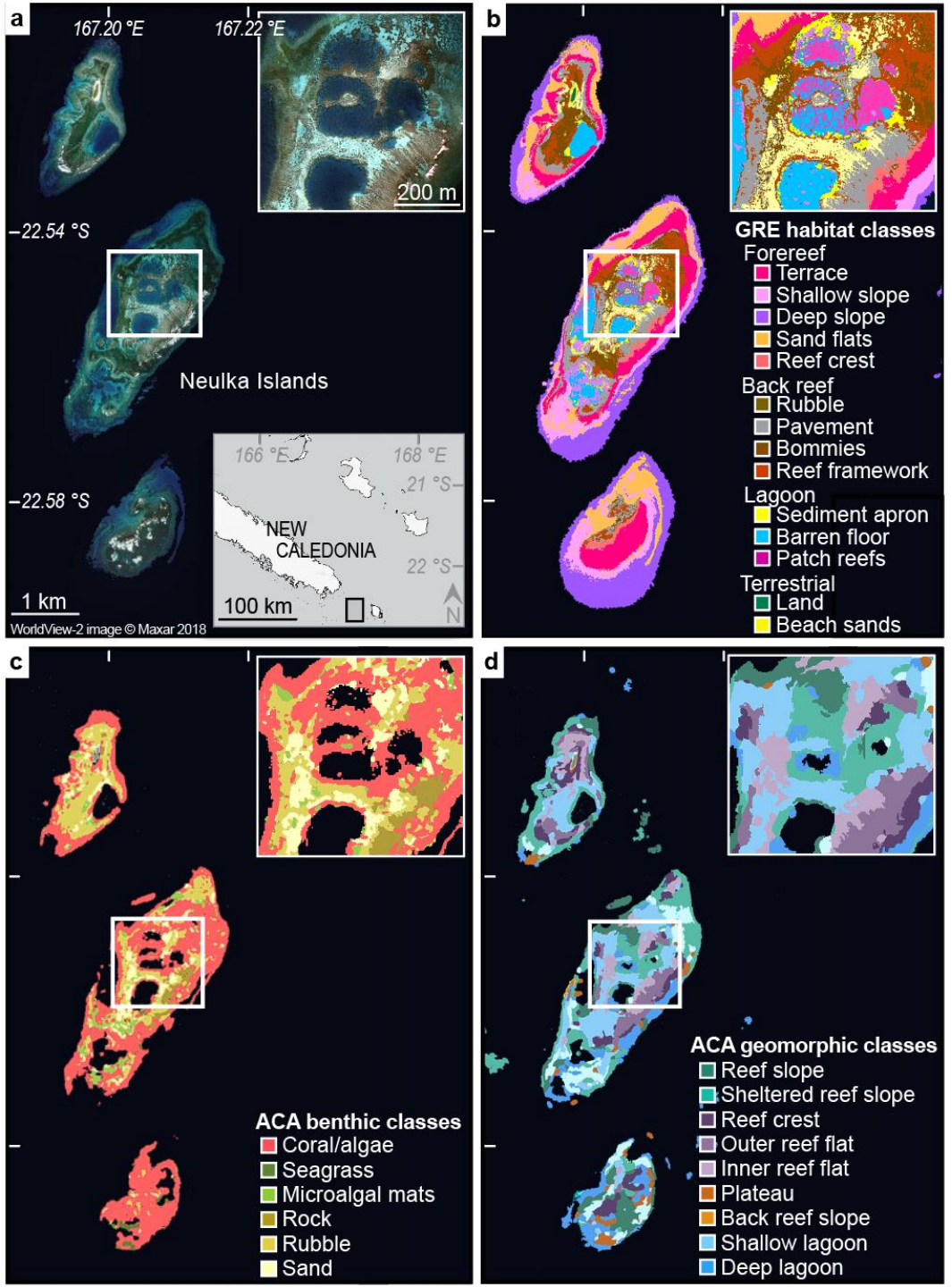
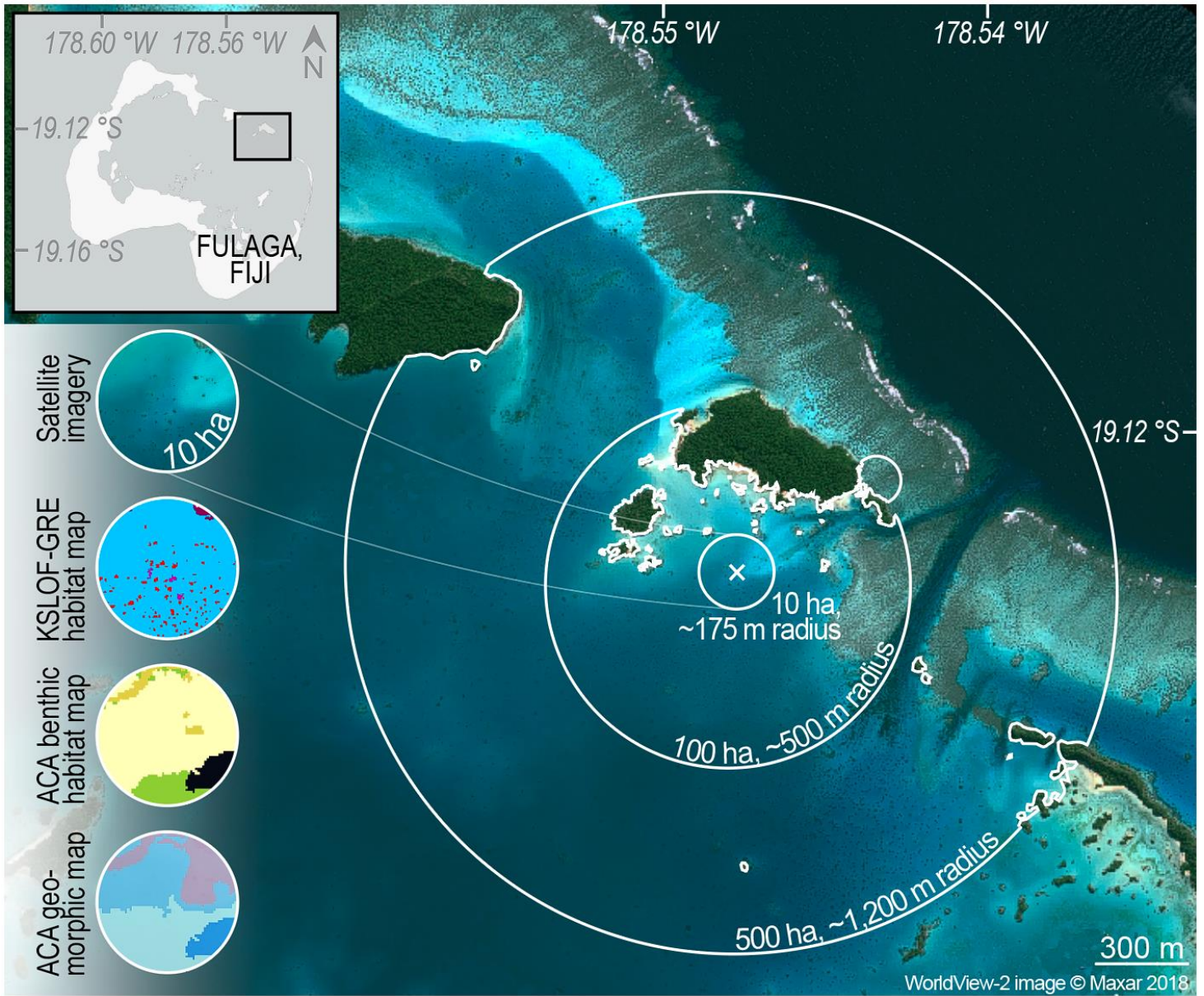


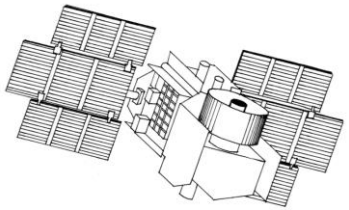
Global Benthic Habitat Maps

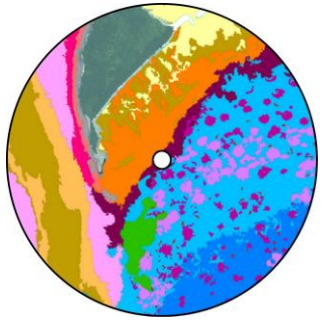


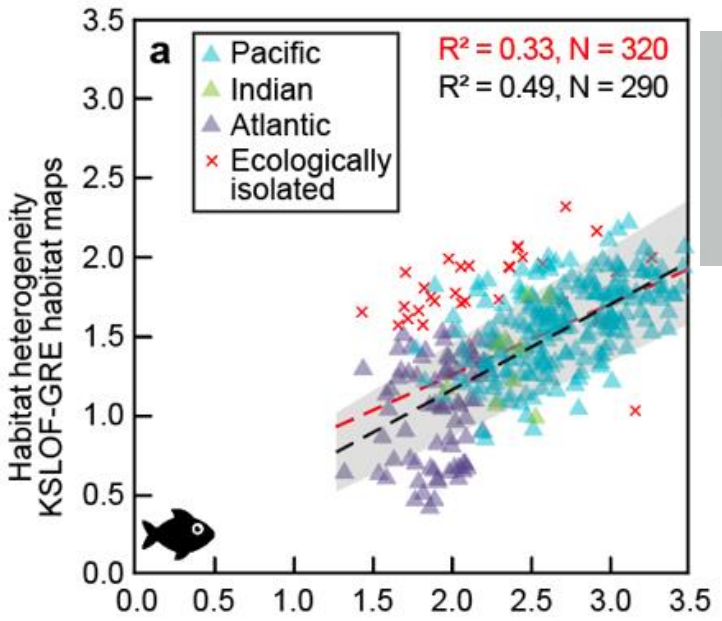


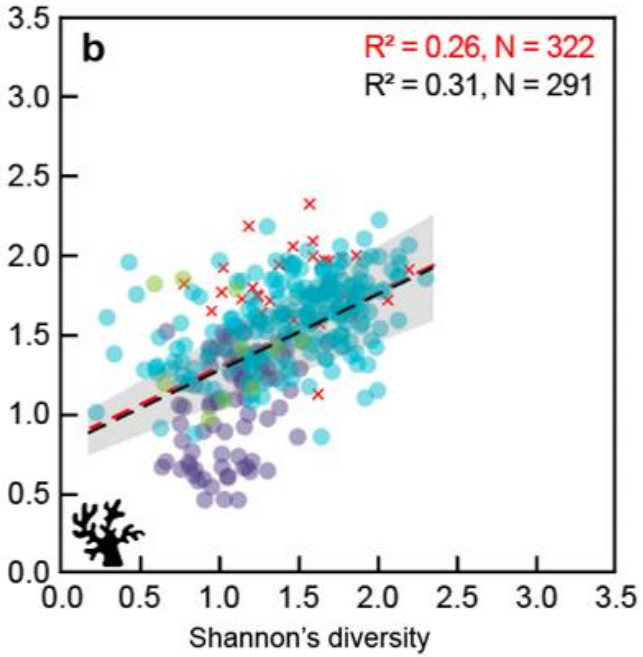
Habitat Diversity Predicts Species Diversity on Coral Reefs

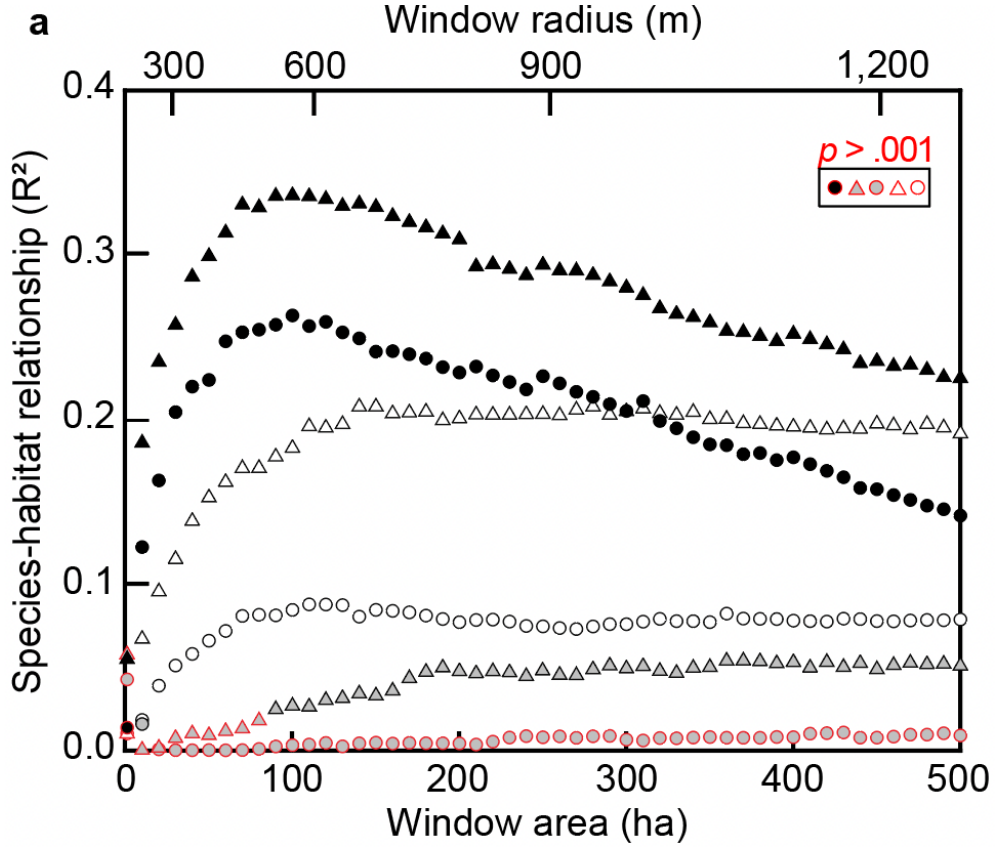
Anna Bakker









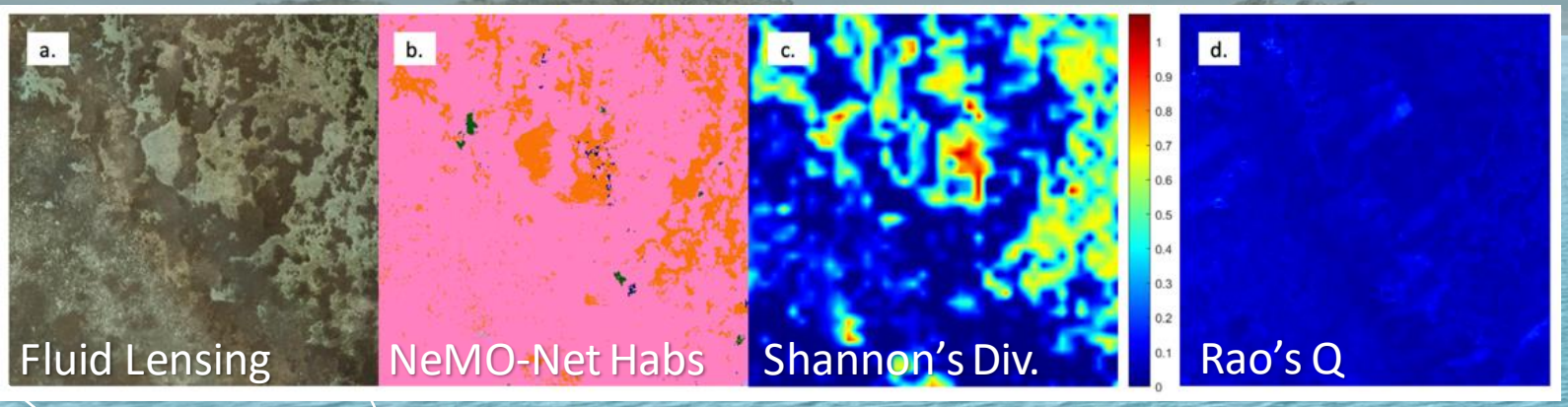


b

		Window	Max R²
KSLOF-GRE habitat	▲	90 ha	0.33
ACA benthic	△	190 ha	0.06
ACA geomorphic	△	140 ha	0.21

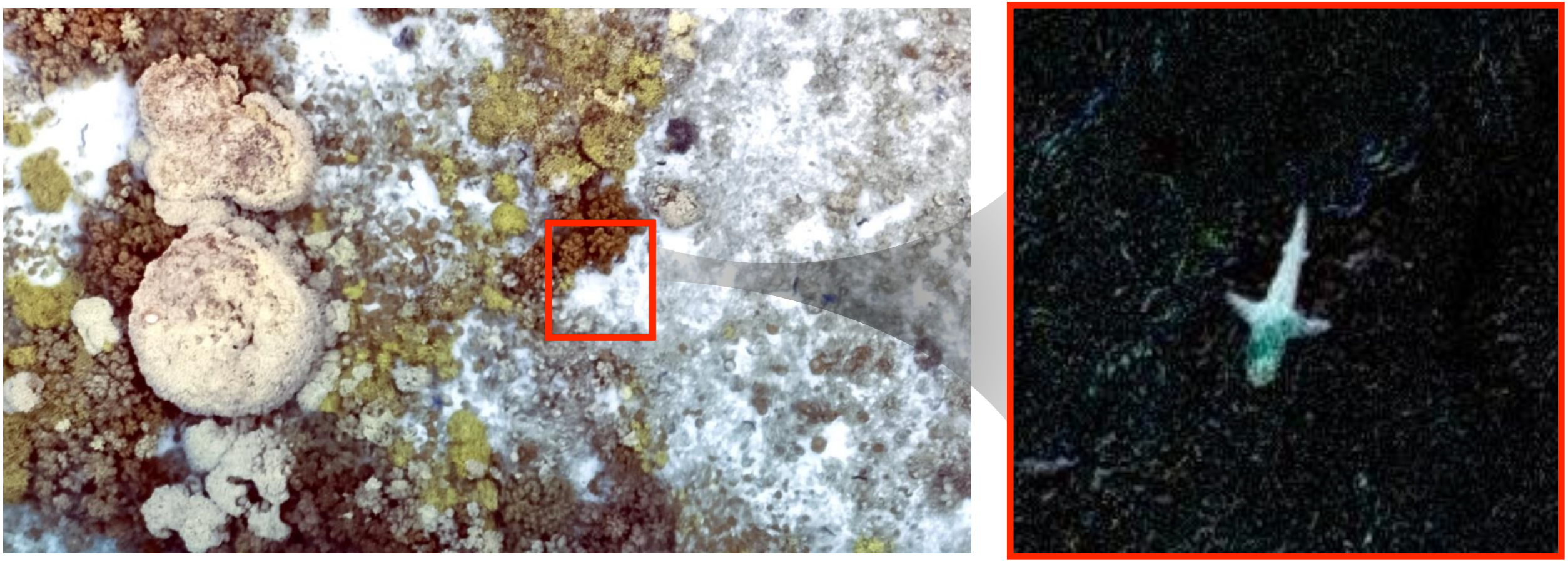
KSLOF-GRE habitat	●	100 ha	0.26
ACA benthic	◎	1 ha	ns
ACA geomorphic	○	110 ha	0.09

α-to-β Diversity Hypothesis and cm-scale



FluidCam

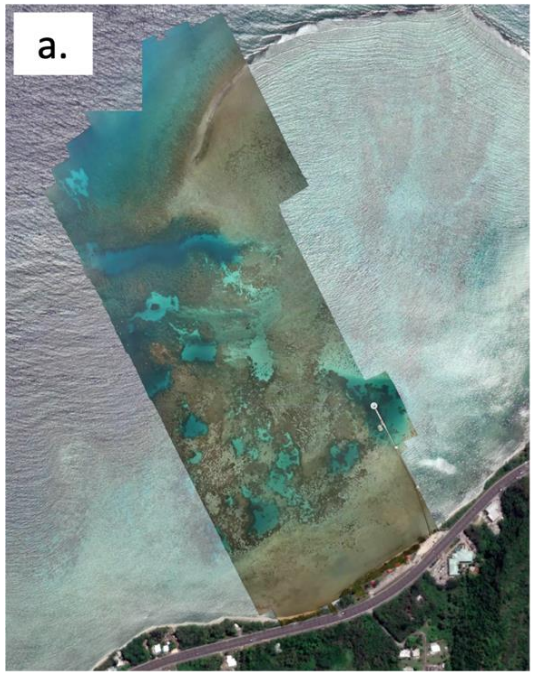
FLUID AIRBORNE FLUID LENSING 2.0 RESULTS IN GUAM

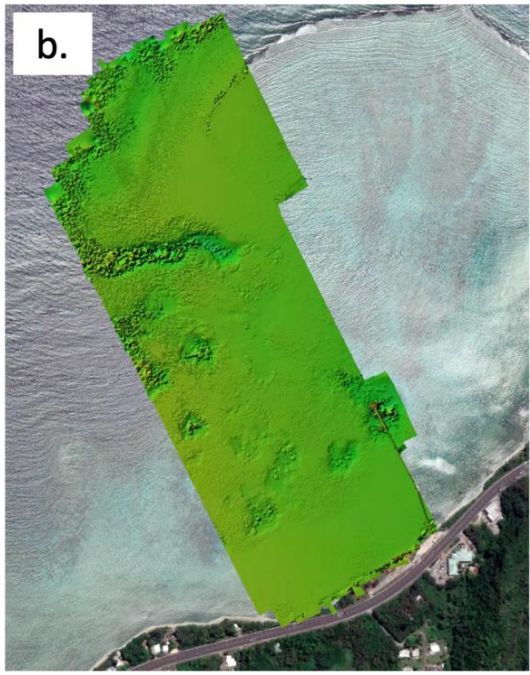


FluidCam

Summer 2022 Field Campaigns

- May and June 2022, ACES Team conducted airborne field campaigns in Hawai'i and Guam
- A busy 2023 summer ahead
- Data visualization site: http://nemonet.info/data-viewer/





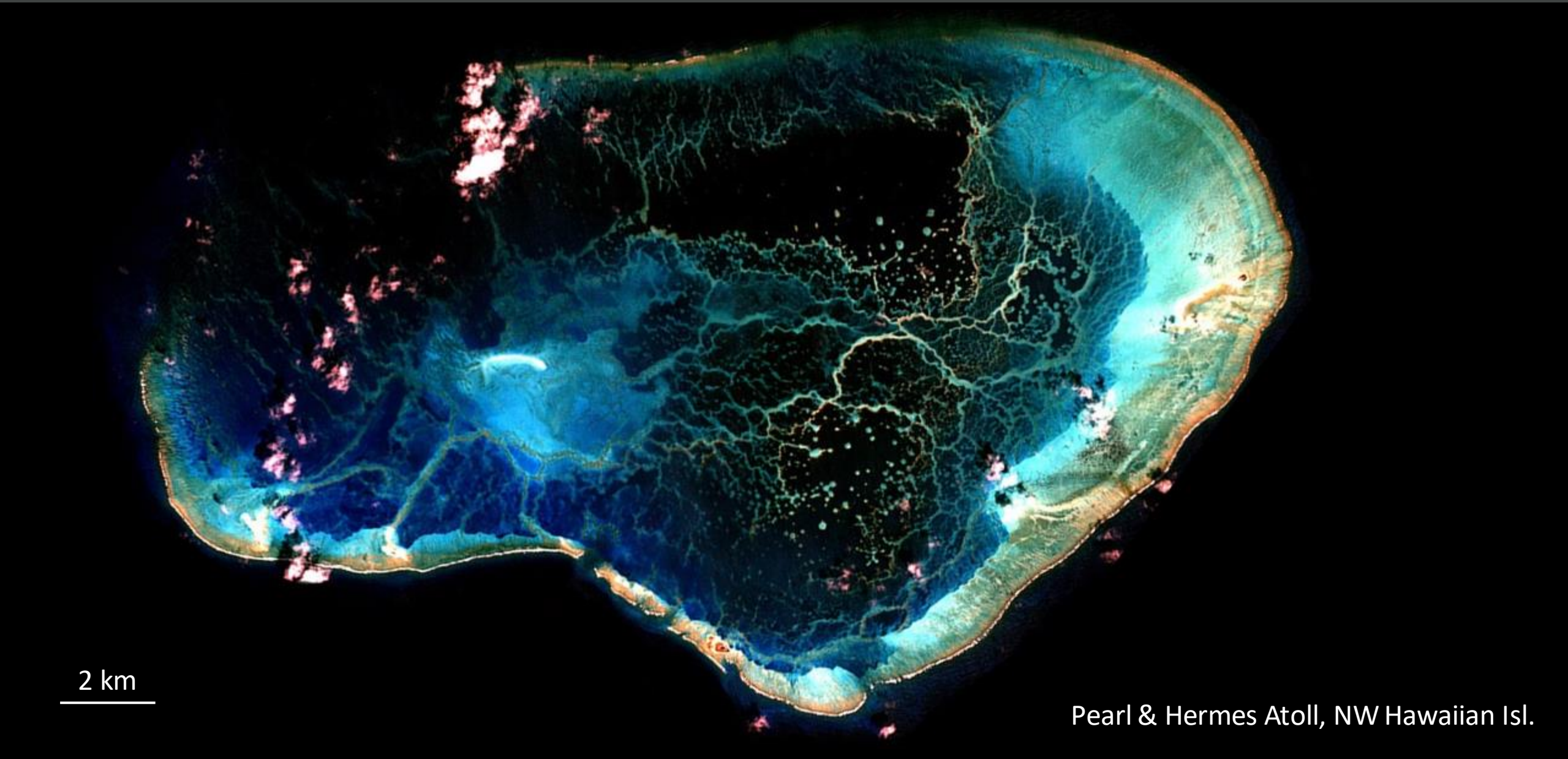
Detecting Ecosystem Transitions from Self-Organization

Predictive power of self-organized patterns:

- Manifest at scales that lend themselves to remote sensing
- Allow determination of the proximity to a tipping point
- Opportunity to examine the link between biotic self-organization, emergent patterning, and ecosystem status
- Detection of ecosystem health based on the scaling rules of life

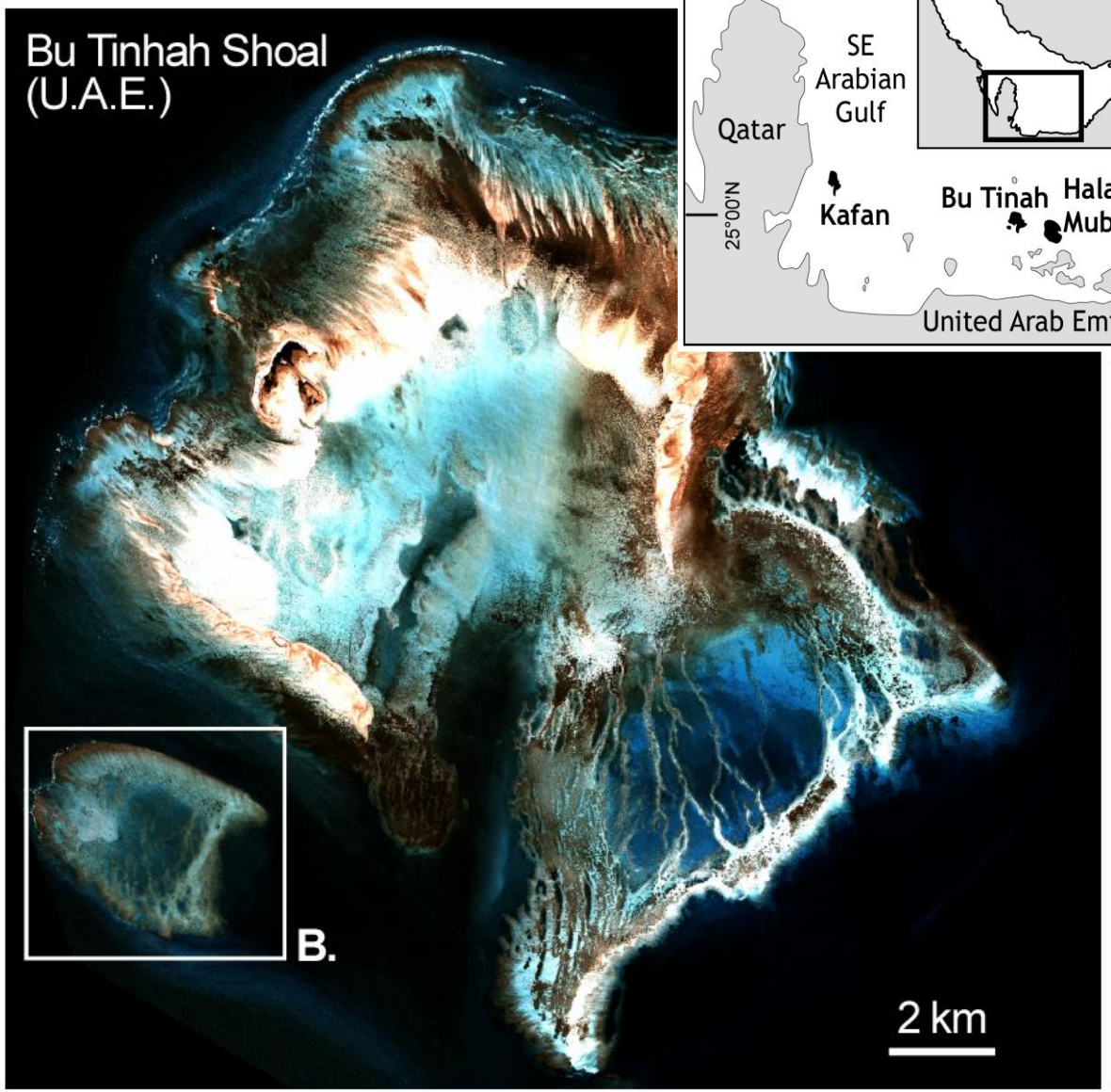
1 km

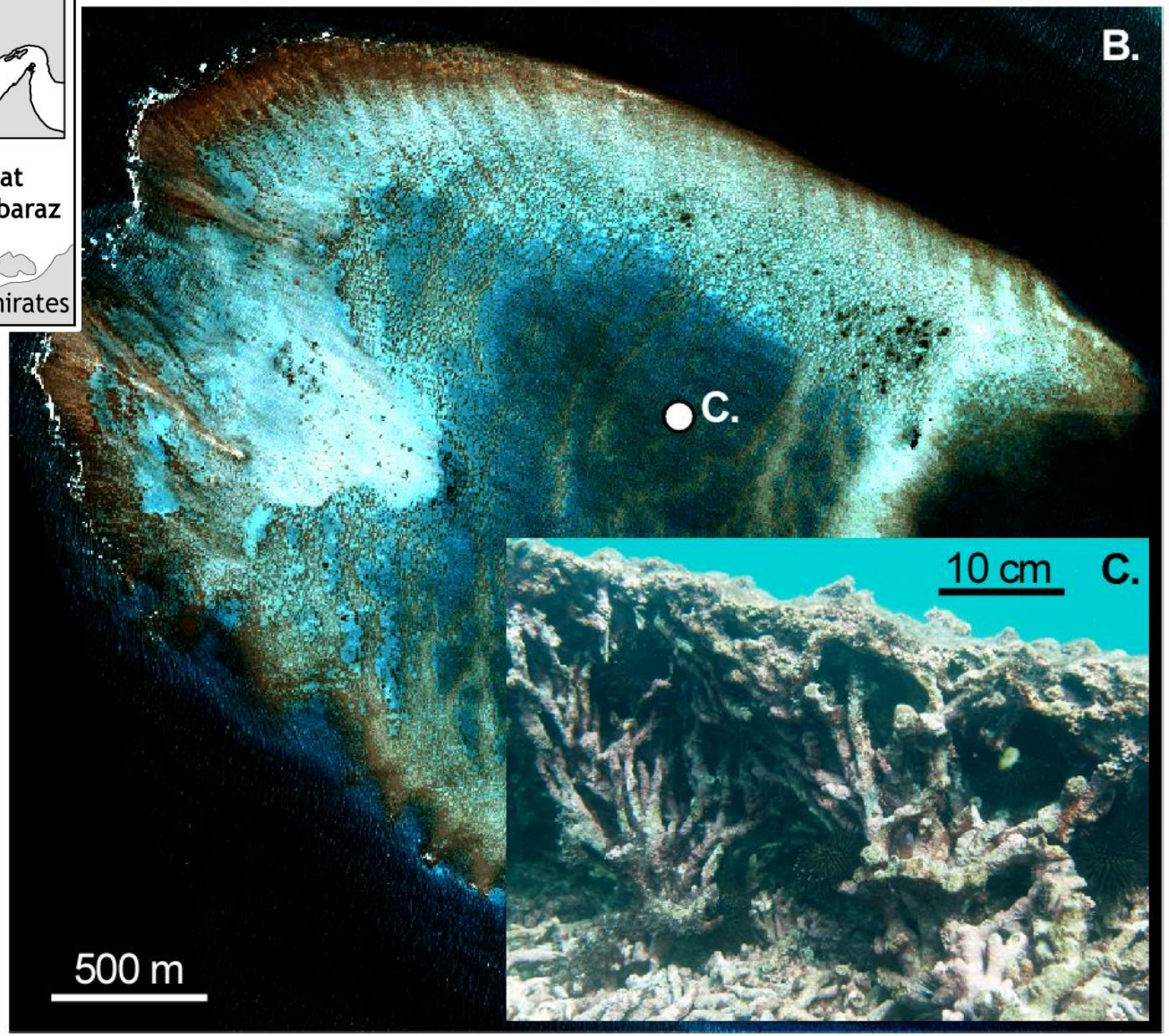
Detecting Ecosystem Transitions from Self-Organization



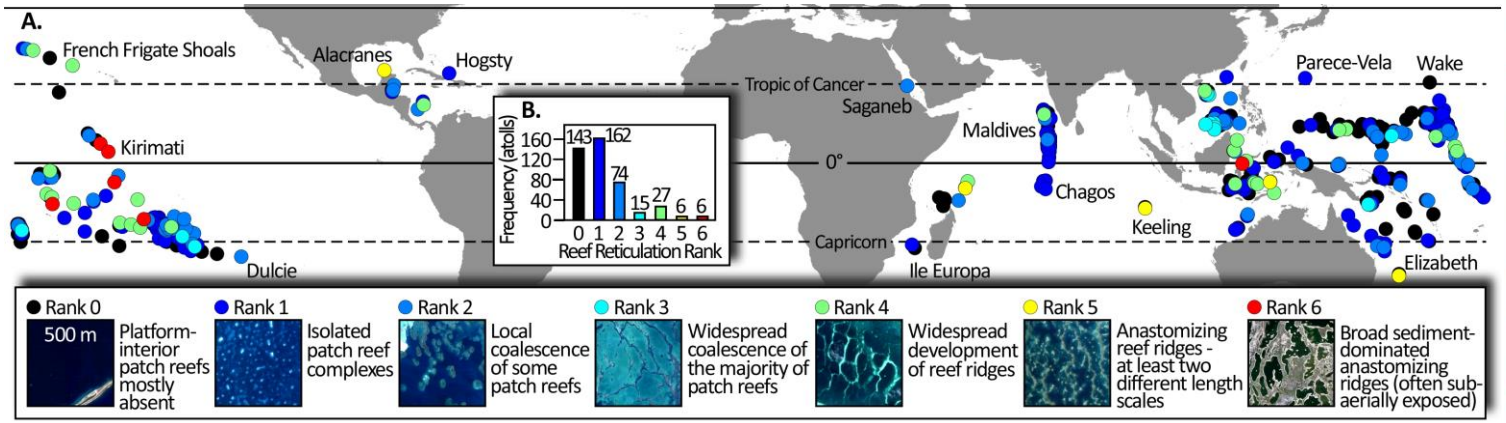
Pearl & Hermes Atoll, NW Hawaiian Isl.

Coherent Patterning of Platform-Interior Reefs

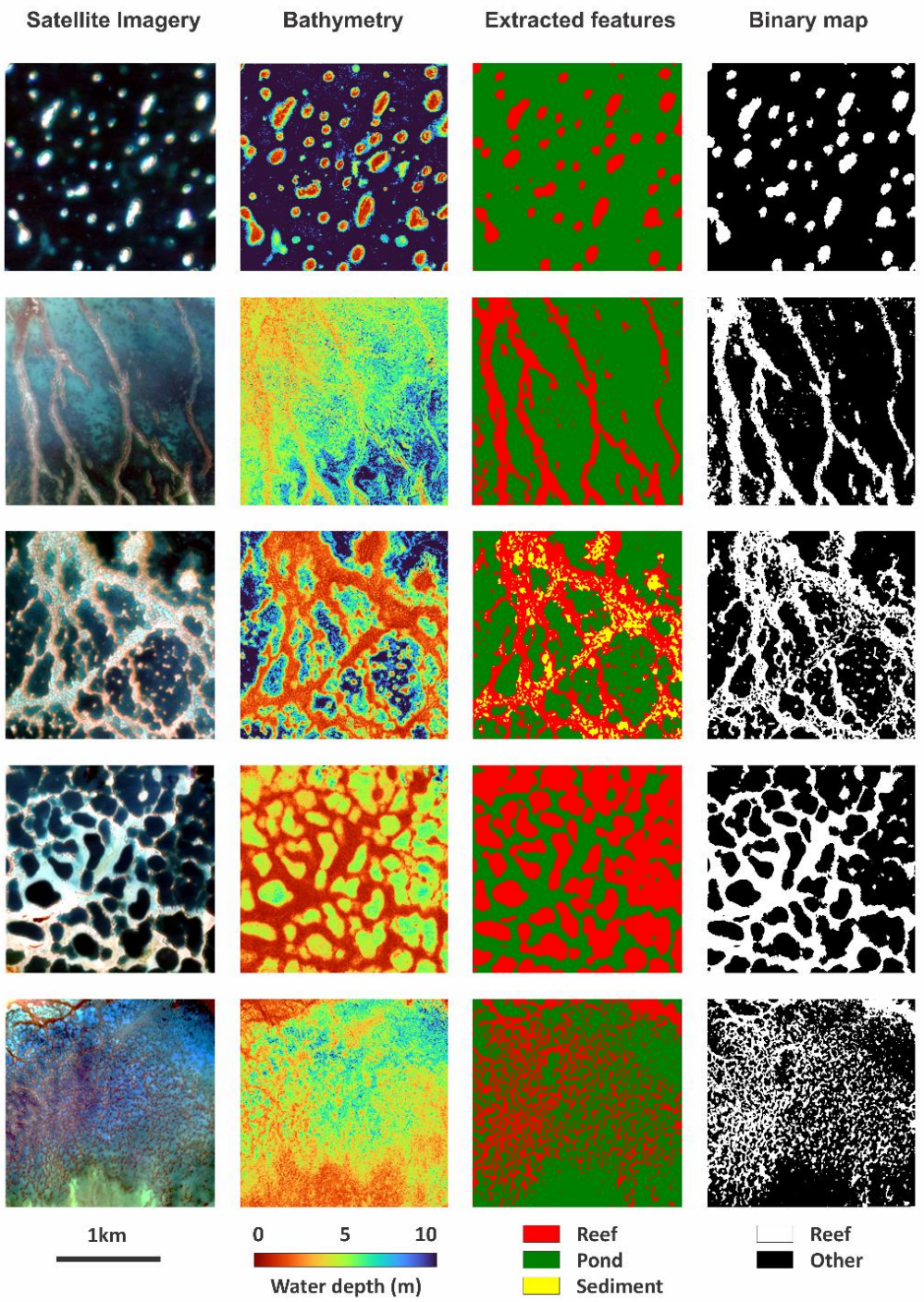




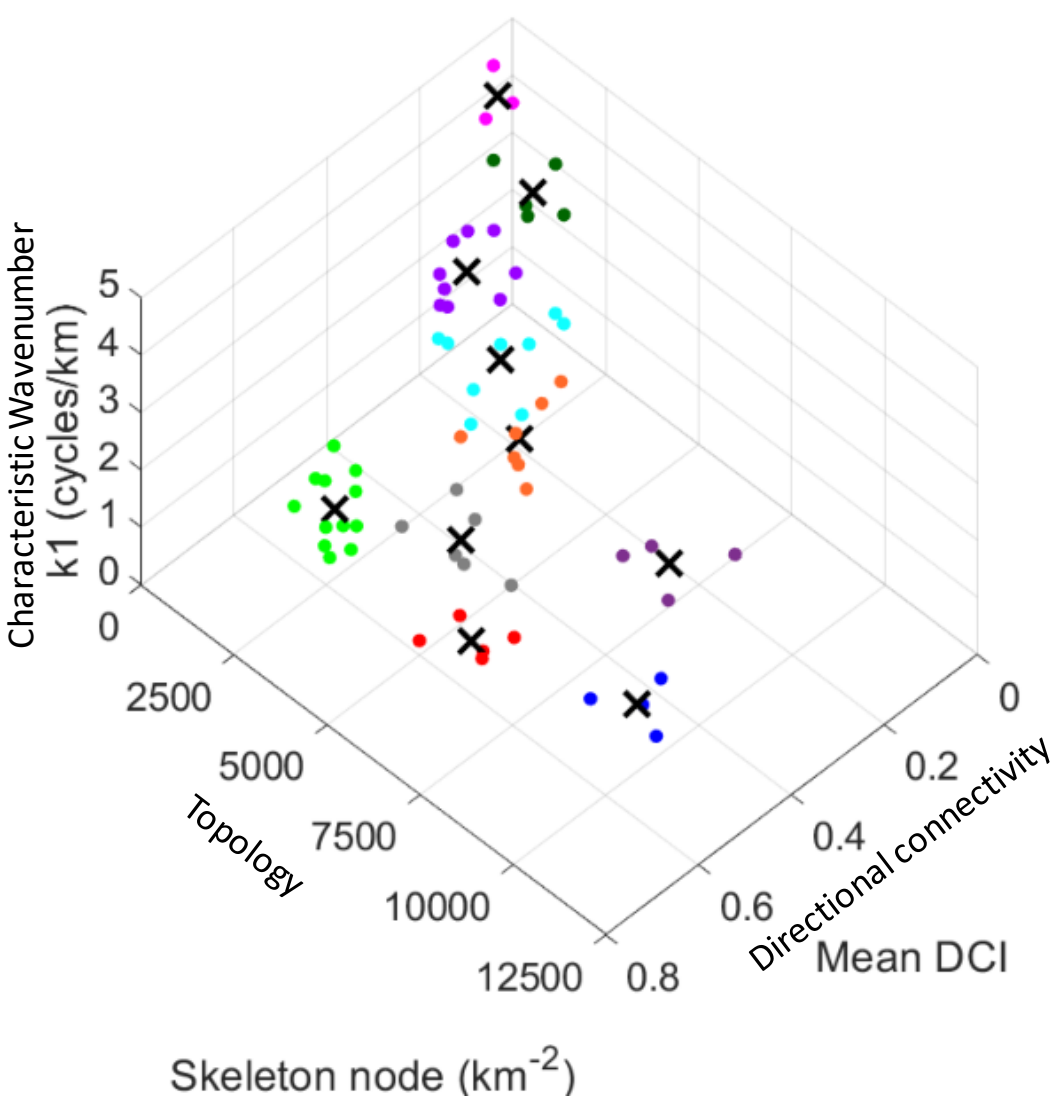
WIDESPREAD RETICULATION

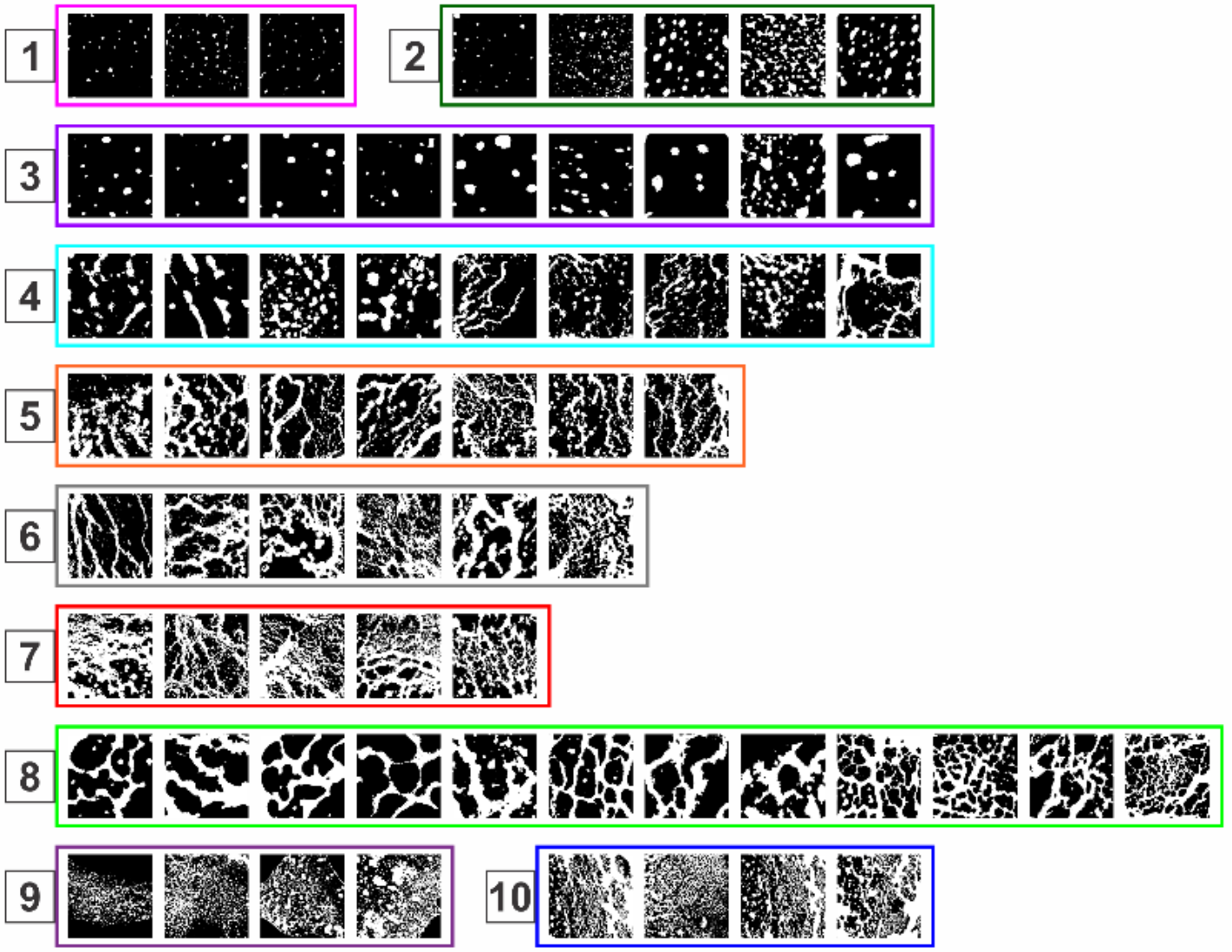


- Geographic and frequency distributions of reticulation ranks for †Goldberg's 433 'Atolls of the World'
- Globally, 30% of atoll lagoons contain reefs with some degree of reticulation
- Note that atolls with high degrees of reef reticulation are spatially clustered

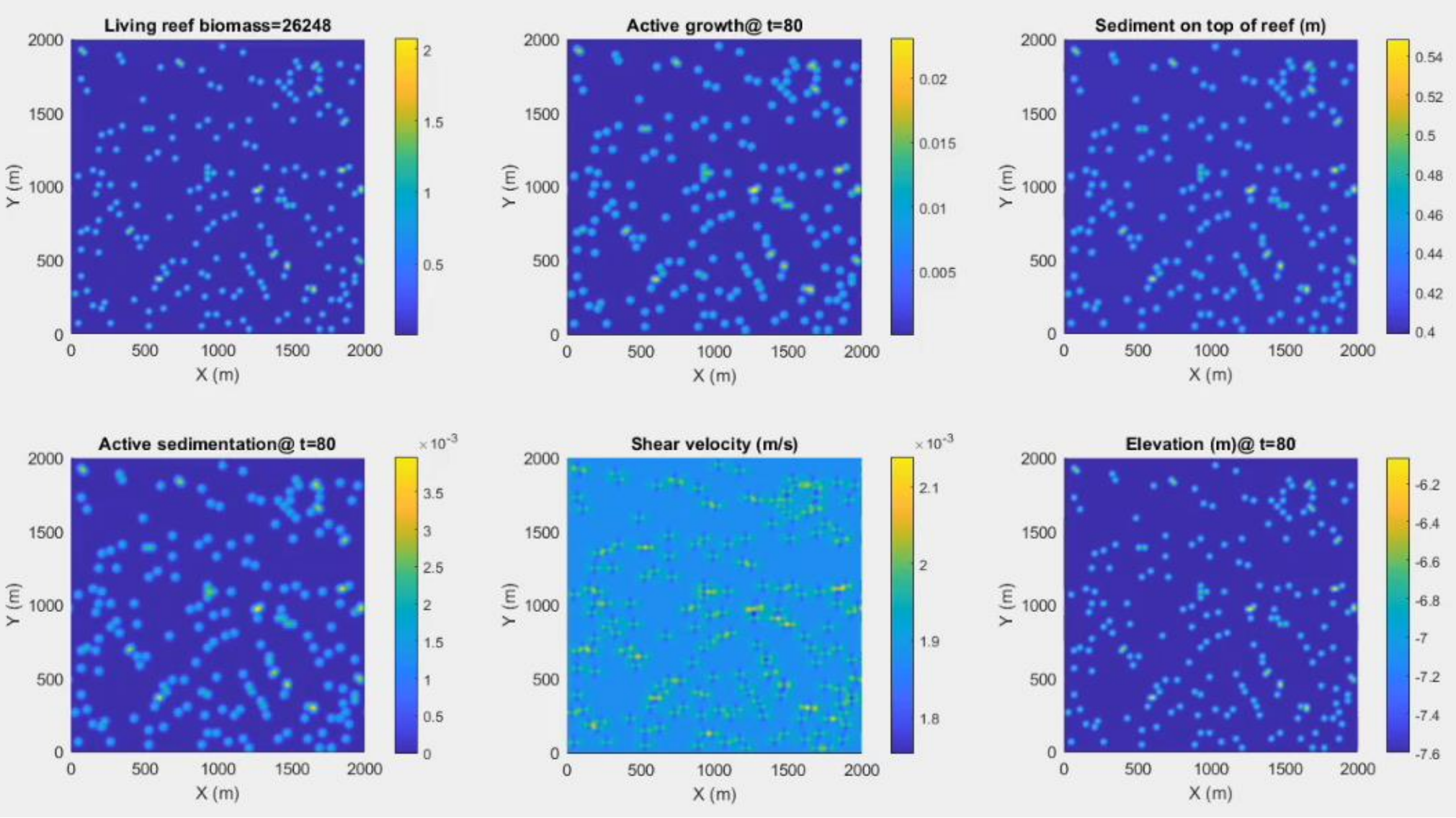


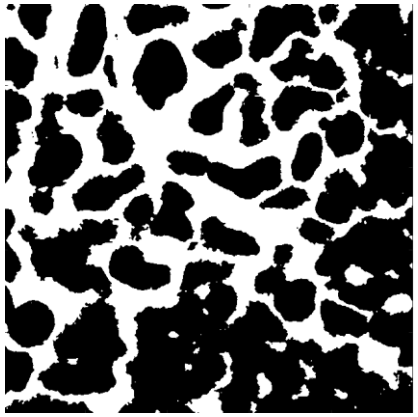
Morphotypes of Emergent Reef Patterning



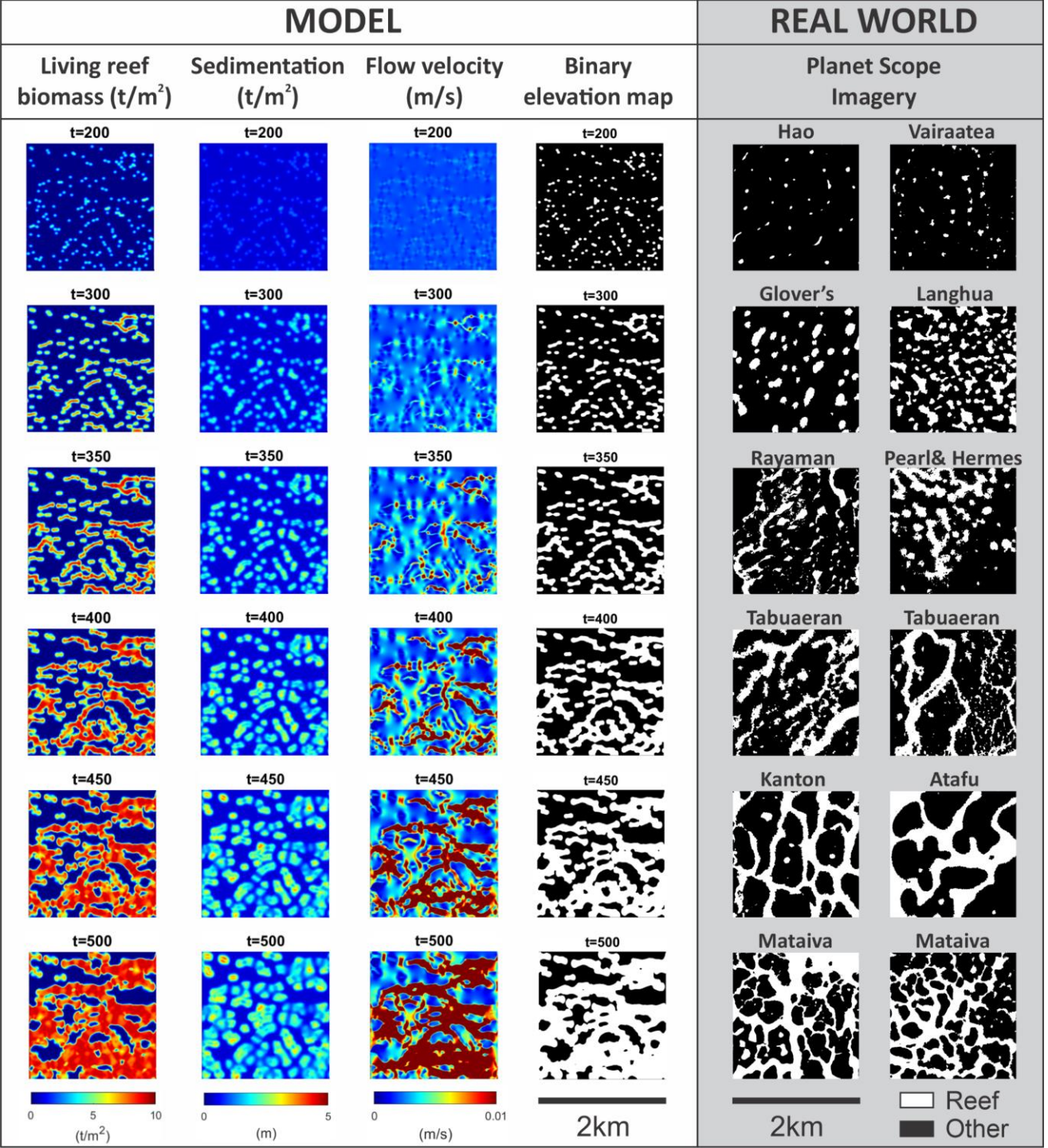


Reaction-Diffusion Model for Reef Pattern Formation





1 km



Dr. Haiwei Xi
Poster Session 2, Wednesday (May 10), 5:00-7:00 PM


QUESTIONS